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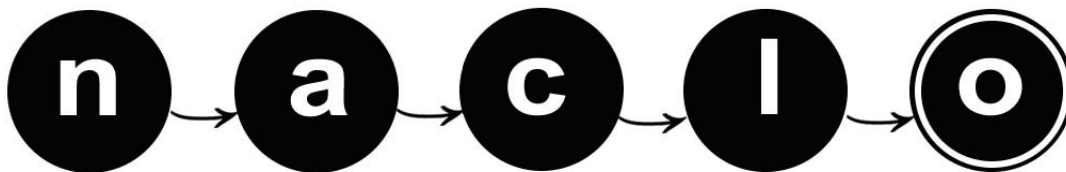
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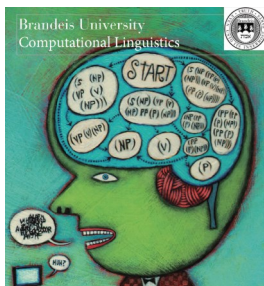
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The Ninth Annual

North American Computational Linguistics Olympiad

2015

www.naclo.cs.cmu.edu

Open Round
January 29, 2015

naclo

Welcome to the ninth annual North American Computational Linguistics Olympiad! You are among the few, the brave, and the brilliant, to participate in this unique event. In order to be completely fair to all participants across North America, we need you to read, understand, and follow these rules completely.

Rules

1. The contest is three hours long and includes eight problems, labeled A to H.
2. Follow the facilitators' instructions carefully.
3. If you want clarification on any of the problems, talk to a facilitator. The facilitator will consult with the jury before answering.
4. You may not discuss the problems with anyone except as described in items 3 & 12.
5. Each problem is worth a specified number of points, with a total of 100 points. In this year's open round, no points will be given for explanations. Instead, make sure to fill out all the answer boxes properly.
6. All your answers should be in the Answer Sheets at the end of this booklet. ONLY THE ANSWER SHEETS WILL BE GRADED.
7. Write your name and registration number on each page:
   Here is an example: Jessica Sawyer   #850
8. The top 100 participants (approximately) across the continent in the open round will be invited to the second round.
9. Each problem has been thoroughly checked by linguists and computer scientists as well as students like you for clarity, accuracy, and solvability. Some problems are more difficult than others, but all can be solved using ordinary reasoning and some basic analytic skills. You don't need to know anything about linguistics or about these languages in order to solve them.
10. If we have done our job well, very few people will solve all these problems completely in the time allotted. So, don't be discouraged if you don't finish everything.
11. If you have any comments, suggestions or complaints about the competition, we ask you to remember these for the web-based evaluation. We will send you an e-mail shortly after the competition is finished with instructions on how to fill it out.
12. **DO NOT DISCUSS THE PROBLEMS UNTIL THEY HAVE BEEN POSTED ONLINE! THIS MAY BE SEVERAL WEEKS AFTER THE END OF THE CONTEST.**

Oh, and have fun!

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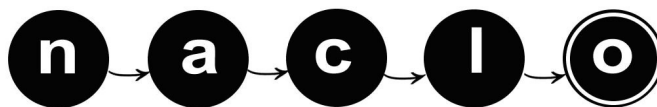
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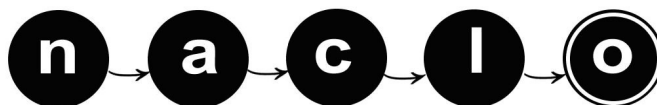
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(A) The Big Dog and the Young Man (1/1) [5 points]

Danish, spoken in Denmark, and Swedish, spoken in Sweden, are closely related languages. This means that they have many similarities.

The English words *the* and *a* are called articles. *The* is called a 'definite article' and *a* is called an 'indefinite article'.

Read the Danish and Swedish phrases below, and look for patterns, similarities and differences. In particular, look at how articles are used. Then complete the exercise below; write your answers in the Answer Sheets.

Danish		Swedish	
en hund	a dog	en hund	a dog
en stor hund	a big dog	en stor hund	a big dog
hunden	the dog	hunden	the dog
den store hund	the big dog	den stora hunden	the big dog

A1. Which of these phrases are Danish and which are Swedish? Write a 'D' for Danish or as 'S' for Swedish in the Answer Sheets.

    a.   en mand   a man
    b.   en ung man   a young man
    c.   manden   the man
    d.   en ung mand   a young man
    e.   den unge mand   the young man
    f.   mannen   the man
    g.   den unge mannen   the young man
    h.   en man   a man

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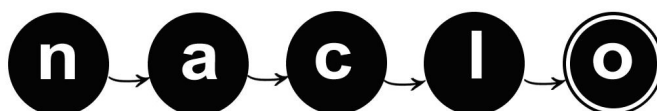
(B) Delphi has the Answers (1/1) [10 points]

Given are Greek toponyms (place names), written in the Greek alphabet (without marking stress), as well as their ancient and modern pronunciations. Note: the middle columns are transcribed using the International Phonetic Alphabet (IPA). ʰafter a consonant denotes that it's aspirated (pronounced with additional breath). x is the *ch* sound in Bach. ɣ is a voiced x; that is it is pronounced with the vocal cords vibrating (just like b is a voiced p). ç is the first consonant in the British pronunciation of hue; ʝ is a voiced ç. θ is the *th* in cloth; ð is a voiced θ as in the *th* in then. : after a vowel denotes length. ɔ is the vowel in caught. ε is the vowel in bet.

B1. Your task is to fill in the blanks. Write your answers in the answer sheets.

	Ancient Greek	Modern Greek	Toponym
Αθως	/atʰɔːs/	/aθos/	Athos
Θουριοι	/tʰourioi/	/θurii/	Thurii
Αργος	/argos/	/arɣos/	Argos
Φρεγελλα	/pʰreɟella/	/frejella/	Fregellae
Χρυση	/kʰrusε:/	/xrisi/	Chryse
Γολγοθα	/golgotʰa/	/ɣolɣoθa/	Golgotha
Δελφοι	/delpʰoi/	/ðelfi/	Delphi
Εφεσος	/epʰesos/	/efesos/	Ephesus
Θεοδωσια	/tʰeodɔːsia/	/θeoðosia/	Theodosia
Αιγινα	/aigina/	/ejina/	Aegina
Καληδονια	/kalε:donia/	/kaliðonia/	Caledonia
Καδμεια	/kadmeia/	/kaðmia/	Cadmea
Σαρδεις	/sardeis/	/sarðis/	Sardis
Φθια	/pʰtʰia/	/fθia/	Phthia
Αχερων	/akʰerɔːn/	/açeron/	Acheron
Χιος	/kʰios/	/çios/	Chios
Θυμαινα	/tʰumaina/	/θimena/	Thymaina
Χαονια	/kʰaonia/	/xaonia/	Chaonia
Μοσχα	/moskʰa/[1]	/mosxa/	Moscow
Βλαχια	(a)	(b)	Romania[2]
Φλεγεθων	(c)	(d)	Phlegethon
Βηρυτος	(e)	(f)	Beirut
(g)	(h)	/frijia/	Phrygia
Βαβυλωνια	(i)	(j)	(k)

[1]There was no Ancient Greek word for Moscow, but if there had been, it'd've been this.
[2]Note: the toponym for Romania in Greek actually refers to a region that initially constituted the kingdom of Romania.

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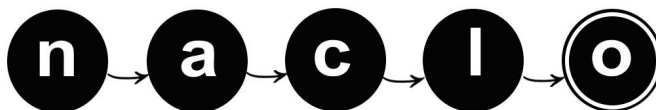
(C) Aymara Rules (1/1) [10 points]

Languages have rules or constraints about how sounds should be put together to make words. Not just any combination of sounds can be a word. Linguists refer to these restrictions on word formation as the phonotactics of a language. There are many types of rules one can write to describe sound patterns. Consider the following three rule types:

Counting Mod 2: These constraints require that a certain sound occur either an even or odd number of times. We write Counting Mod 2 constraints as follows: either *X=Even*, meaning the sound X must occur an even number of times, or *X=Odd*, meaning the sound X must occur an odd number of times. For example, *b=Even* requires that there be an even number of b's in every word. Thus, *b=Even* rules out words like "bas" or "bisbanib" while allowing words like "tas" or "bistanib". The rule *b=Odd* would do the exact opposite: allow "bas" and "bisbanib" but rule out "tas" and "bistanib".

Strictly 2-Local: These constraints prohibit two sounds from occurring right next to each other...meaning that X and Y cannot occur right next to each other in any order. For example, *bn* prohibits a b right before an n and an n right before a b. Thus, *bn* rules out "abnik" and "anbik" as possible words, while allowing words like "atnik" or "abanik".

Strictly 2-Piecewise: These constraints prohibit two sounds from occurring together in the same word… meaning that X and Y must not occur in the same word, no matter what may or may not come in between them. For example, *[bn]* prohibits words with both b and n. Like *bn*, *[bn]* allows words like "atnik" and rules out "abnik", but unlike *bn*, *[bn]* also rules out "abanik" and "anabik".

Out of these three types of rules, only two are known to be needed when describing the phonotactics of human languages. In this problem, you will write constraints in the forms just described in order to account for some of the phonotactics of Bolivian Aymara, an indigenous language spoken in Bolivia. The following is a list of acceptable and unacceptable words in Aymara:

Acceptable:				
tama	pisi	kikpa	putu	jaqet
weqo	janana	oqara	qolqeni	mayni
unoqeña	purapa	kunka	taqe	nayra
kawki	alwa	tarkaka	jiliri	tukjata
sipita	qawa	qemi	qapa	tiwula

Unacceptable:		
waketi	kutaqa	maqetaqi
uteka	qaqira	taqaki
jakaqe	temaka	kape

Answer these questions in the Answer Sheets.

C1. Write a set of constraints that will rule out all of the bad forms while permitting all of the good forms. Use as few constraints as possible. Follow the format described above for writing constraints. Note: you don't need to account for every pattern you might find. You will lose points only for ruling out the acceptable forms, failing to rule out the unacceptable forms, or using more constraints than necessary.

C2. Which type of constraint isn't needed?
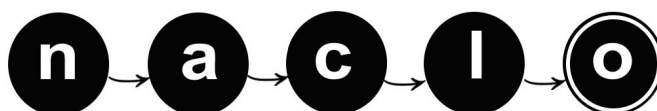
(D) Elder Futhark Runes (1/1) [10 points]

Old Norse was the language of the Vikings, the language spoken in Scandinavia and in the Scandinavian settlements found throughout the Northern Hemisphere from the 700s through the 1300s. Much as Latin was the forerunner of the Romance languages, among them Italian, Spanish, and French, Old Norse was the ancestor of the North Germanic languages: Icelandic, Faroese, Norwegian, Danish, and Swedish. Old Norse was written first in runic alphabets, then later in the Roman alphabet. The first runic alphabet, found on inscriptions dating from throughout the first millennium CE, is known as "Elder Futhark" and was used for both proto-Norse and early Old Norse.

Below are nine Anglicized names of Old Norse gods and the nine Elder Futhark names to which they correspond. Listed below are also two other runic names for gods.

Anglicized names

a. Baldur   b. Dallinger   c. Day   d. Earth   e. Freya   f. Freyr   g. Ithun   h. Night   i. Sun

Old Norse Runes

(1) ᛒᚨᛚᛞᚱ   (4) ᛞᚨᚷᚱ   (7) ᛋᚢᚱᚦ   (10) ᚢᛗᛁᛏ

(2) ᚦᚢᚱ   (5) ᛏᚢᛏᛏ   (8) ᛞᛖᛚᛁᚢᛗᚱ   (11) ᛉᚢᚱ

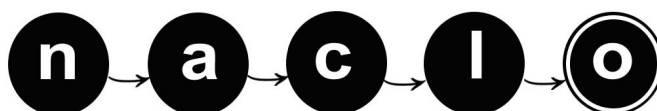(3) ᛁᚦᚢᛏᛏ   (6) ᚠᚱᛖᛁᛋᚠ   (9) ᚠᚱᛖᛁᚱ

Answer these questions in the Answer Sheets.

D1. Match the Anglicized names to the correct Elder Futhark names.

D2. What are the two leftover Elder Futhark names, in the Roman alphabet?

D3. Write the runic names of the following gods:

a. Tyr
b. Ran
c. Sif

(E) Use the Force (1/1) [15 points]

Yoda, the lovable green Jedi from the Star Wars franchise, speaks the same language as most of the other characters in the series (a language that seems a whole lot like English). However, his sentences don't sound completely normal to our ears because he inverts (swaps the order of) pairs of phrases before speaking. For example, if Yoda were to say "believe you I don't" we know a non-Yoda speaker saying the same thing would say "I don't believe you." We can mark Yoda's sentences to recover the original sequence with the following hierarchical annotation:

< [believe you] [I don't] >

The "[ ]" means preserve the relative order of the phrases inside the brackets (of which there must be exactly two) and the "< >" means invert the order. So in this case the annotation means "you" comes after "believe" and "don't" comes after "I", but "I don't" comes *before* "believe you". Here's another example:

< patience [< must you > have] >   becomes   you must have patience

This method of forming Yoda-isms is an example of an unlabeled inversion transduction grammar, a powerful formalism used in machine translation.

Answer these questions in the Answer Sheets.

E1. For each of these annotated Yoda-isms, write down the original sentence

    a.   < go [you must] >
    b.   < [strong [with [the force]]] < [this [one is]] < think I > > >
    c.   < [< < home [milk < coming before >] > [< to forget > < up pick >] > tonight] < don't please > >

E2. For each of these Yoda-isms of the sentence "use the Force Luke" write the annotation that recovers the original. If no such annotation is possible write "NOT POSSIBLE". If more than one annotation that recovers the original sentence is possible, choose any legal annotation but write "MORE POSSIBLE" next to the answer.

    a.   use Force Luke the
    b.   Luke the Force use
    c.   Luke Force the use
    d.   the Luke use Force
    e.   the Luke Force use

E3. If Yoda were not bound by the rules of this puzzle and could reorder the four words of the sentence "use the Force Luke" in any way he likes, how many ways could he do this?

E4. Since Yoda *is* bound by the rules of this puzzle, how many ways can he actually reorder "use the Force Luke"?

E5. For each of the following sentences, write down the number of unique permutations of the sentence and the number of unique Yoda-isms that can be formed from the sentence. Note the original sentence does count as one of the permutations.

   a.   do or do not
    b.   Luke I am your father
    c.   a galaxy far far away
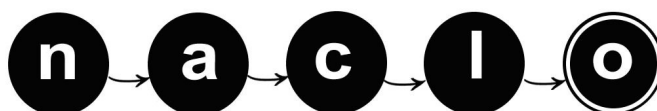
(F) My Friend Nomura from Osaka (1/1) [15 points]

In Japanese as in many languages, proper names (names of people and places) often have a literal translation that describes some local feature (e.g. Littlefield, Whitehill, Longridge). Here are some Japanese personal or place names and their jumbled up literal translations into English.

F1. Your task is to match up the names and the translations; write your answers in the Answer Sheets. Note that Japanese distinguishes long and short vowels, but that vowel length distinction is not shown here. Note also that in these examples, 'mount' and 'mountain' are different words, as are 'field' and 'rice-field'.

English spelling of Japanese names	English
1. Ota	A. Big slope
2. Nakayama	B. Tree river
3. Kigawa	C. Slope of the mountain
4. Kazan	D. Field village
5. Murakami	E. Above the village
6. Kagawa	F. Above the river
7. Ono	G. Middle of the rice-field
8. Nomura	H. Little field
9. Tanaka	I. Middle mountain
10. Sakuragi	J. Original rice-field
11. Nihon	K. Cherry tree
12. Osaka	L. Fire mount (= volcano)
13. Yamazaka	M. Big rice-field
14. Kawakami	N. Fire river
15. Honda	O. Origin of the sun (= Japan)

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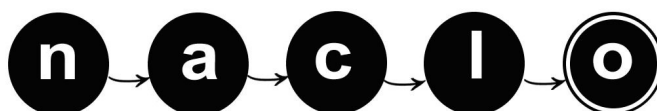
(G) Zoink! (1/2) [15 points]

As everyone who needs to buy sprockets online knows, the crowd-sourced website Zoink! is the place to go to get real evaluations from real users on real sprockets. You might have the most optaxic sprocket out there, but unless it's getting reviewed on Zoink! nobody's going to hear about it.

To ensure quality, the administrators of Zoink! have to continuously delete reviews written by bots, small software programs that pretend to be human reviewers. The admins can't read every review by hand so they first need to pre-filter obvious garbage. Thankfully, one common mistake bots make is in using multiple adjectives that describe different degrees of a quality in an improper way. (You can think of the adjectives on a scale of intensity, with different scales for different qualities from low intensity to high intensity.) There are correct and incorrect ways of using such 'scalar' adjectives when describing sprockets. For example, the phrase:

good but not great (CORRECT)

is perfectly acceptable and should be marked as such. But this phrase:

furious but not angry (WRONG)

makes no sense since *furious* is stronger that *angry* and therefor strictly subsumes *angry* - you can be angry but not so much as to be furious, but you cannot be furious and not be angry. Any review containing this phrase should be thrown away immediately since it definitely came from a bot rather than a human speaker.

There are also some unclear cases. This phrase:

furious but not good (MAYBE)

seems odd since it compares two adjectives from different scales (anger and goodness). Such a review should raise a red flag but be inspected more closely before being thrown out.

Oh but the sprocket marketplace is incredibly hip and so everyone writes using the latest slang. In order to write filtering software, the Zoink! admins (who are not so hip) first looked at a bunch of snippets from reviews written by real people. Here they are:

1. cromulent but not melaxious
2. not only efrimious but quarmic
3. not only hyxilious but fligranish
4. not only daxic but fligranish
5. not laxaraptic, but just hyxilious
6. not just melaxious but efrimious
7. not only quarmic, but nistrotic
8. shtingly, though not efrimious
9. not tamacious, just efrimious
10. not optaxic, just fligranish
11. not only cromulent but shtingly
12. not nistrotic, but just efrimious
13. not nistrotic, just tamacious
14. wilky but not daxic
15. not daxic, just jaronic
16. jaronic but not hyxilious
17. laxaraptic but not optaxic
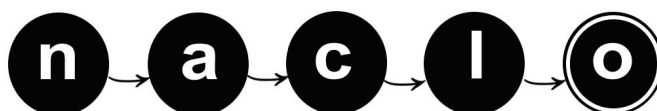
(G) Zoink! (2/2)

Based on these snippets, the admins were able to understand how the different properties are connected so they were ready to decide whether further snippets were
- CORRECT, i.e. they might easily have been written by humans
- WRONG, i.e. they must have been written by bots
- MAYBE, i.e. they might have been written by humans or by bots because they combine points on different scales.

Here is a selection of the further snippets:

  A.   not only hyxilious but quarmic

  B.   jaronic but not laxaraptic

  C.   cromulent but not nistrotic

  D.   not only tamacious, but melaxious

  E.   not only shtingly but quarmic

  F.   not fligranish, just wilky

  G.   optaxic but not hyxilious

  H.   cromulent but not jaronic

  I.   not just optaxic but nistrotic

G1. Can you figure out which of the snippets A-I belong to which category below? Write your answers in the Answer Sheets.

     a. CORRECT (4 snippets)
     b. WRONG (2 snippets)
     c. MAYBE (3 snippets)
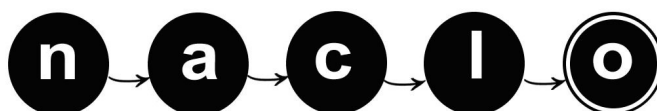
(H) Phàasàa and Pháasăa (1/2) [20 points]

Shan (native term: Phàasàa Tái, ၽႃႇသႃႇတႆး) and Lao (native term: Pháasăa Láaw, ພາສາລາວ) are Tai languages from Southeast Asia. Shan is spoken in Myanmar and Thailand by about 3 million people, and Lao is spoken in Laos and Thailand by about 20 million. They are quite closely related, but are essentially mutually incomprehensible due to grammatical changes in both languages. Similarly, they are both written in writing systems that descend from the ancient Sanskrit script Brahmi, but these writing systems have rather different ways of marking the same sounds. The Shan writing system is a modification of the alphabet used by Burmese and Mon, whereas the Lao script is a streamlined form of the Thai alphabet.

Note: the diacritics (accent marks) above the Shan and Lao vowels in the Roman transcription of the native terms for the two languages shown above serve to mark tone. The doubled vowels indicate long vowels.

H1. Your task is to determine what goes in the blanks in the Shan and Lao columns; write your answers in the Answer Sheets. If you think that more than one answer is possible, write the likeliest one first, then the second-likeliest, and so on.

Shan	Lao	English	Shan	Lao	English
တွင်�း

ທ້ອງ	belly	လိူတ်း	ເລືອດ	blood
လုၵ်ႈ	ລູກ	child	ထၢင်ႇ	ຊ້າງ	elephant
မၢၵ်ႇ	ໝາກ	fruit	မိတ်ႈ	ມີດ	knife
ၽႃႉ	ຜ້າ	large knife	သၢႆႉ	ຊ້າຍ	left
ၼိူဝ်ႇ	ເນື້ອ	meat	ၼႃႉ	ນ້າ	mother's younger sibling
ၼွၵ်ႈ	ນອກ	outside	ၵၢပ်ႇ	ກາບ	pith
ႁၢၵ်ႈ	ຮາກ	root	ထိူၵ်ႈ	ເຂືອກ	rope
လႅတ်ႇ	ແດດ	sun	သိုဝ်ႉ	ຊື້	to buy
ၵဵဝ်ႈ	ຄ້ຽວ	to chew	လိူၵ်ႈ	ເລືອກ	to choose
တၢၵ်ႇ	ຕາກ	to dry in the sun	ဢွတ်ႇ	ກອດ	to embrace
...	ຮູ້	to pound	...	...ອກ	to pound

(H) Phàasàa and Pháasǎa (2/2)

Shan	Lao	English
ပ�်တ်ႇ	ແຜດ	to roar
တႅၵ်ႇ	ແຕກ	to split
လိၼ်း	ລີ້ນ	tongue
မႆႉ	ໄມ້	wood
မွပ်ႇ	(b)	to crouch
(d)	ແປດ	eight
(f)	ເປືອກ	rind

Shan	Lao	English
သွၵ်ႈ	ຊອກ	to seek
လုတ်ႇ	ດູດ	to suck
ပိၵ်ႇ	ປີກ	wing
ႁၢႆႉ	(a)	bad
လၢၵ်ႈ	(c)	to pull
(e)	ມ້າ	horse

H2. Out of the symbols ႈ, ်, and ဝ6 in Shan, and ໄ, ງ, and ້ in Lao, which represent consonants, which vowels, and which tones?
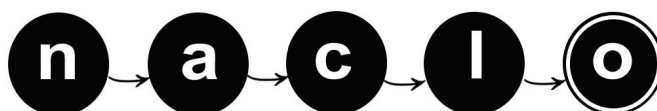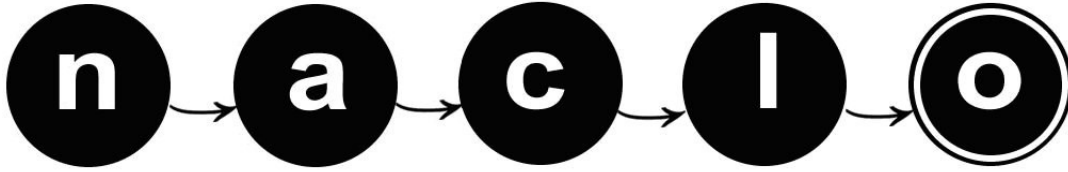
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Contest Booklet

REGISTRATION NUMBER			

Name: _____

Contest Site: _____

Site ID: _____

City, State: _____

Grade: _____

Start Time: _____
End Time: _____

Please also make sure to **write your registration number and your name on each page** that you turn in.

SIGN YOUR NAME BELOW TO CONFIRM THAT YOU WILL NOT DISCUSS THESE PROBLEMS WITH ANYONE UNTIL THEY HAVE BEEN OFFICIALLY POSTED ON THE NACLO WEBSITE IN APRIL.

Signature: _____

Answer Sheet (1/3)

(A) The Big Dog and the Young Man

1. a. ☐   b. ☐   c. ☐   d. ☐   e. ☐   f. ☐   g. ☐   h. ☐

(B) Delphi has the Answers

1. a. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   b. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   c. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   d. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   e. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   f. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   g. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   h. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   i. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   j. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

   k. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

(C) Aymara Rules

1. ☐   ☐   ☐   ☐   ☐   ☐

   ☐   ☐   ☐   ☐   ☐   ☐

2. ☐

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Answer Sheet (2/3)

(D) Elder Futhark Runes

1. a. ☐   b. ☐   c. ☐   d. ☐   e. ☐   f. ☐   g. ☐   h. ☐   i. ☐

2. ☐☐☐☐☐☐☐   ☐☐☐☐☐☐☐

3. a. ☐☐☐☐   b. ☐☐☐☐☐

    c. ☐☐☐☐

(E) Use the Force

1. a. ☐

    b. ☐

    c. ☐

2. a. ☐

    b. ☐

    c. ☐

    d. ☐

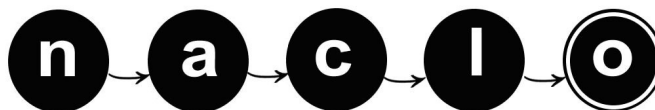   e. ☐

3. ☐

4. ☐

5. a. Permutations ☐   Yoda-isms ☐

    b. Permutations ☐   Yoda-isms ☐

Answer Sheet (3/3)

(E) Use the Force (cont.)

   c.   Permutations   [   ]   Yoda-isms   [   ]

(F) My Friend Nomura from Osaka

1. [ ]   2. [ ]   3. [ ]   4. [ ]   5. [ ]   6. [ ]   7. [ ]   8. [ ]   9. [ ]   10. [ ]

11. [ ]   12. [ ]   13. [ ]   14. [ ]   15. [ ]

(G) Zoink!

1. a. CORRECT   [ ]   [ ]   [ ]   [ ]

   b. WRONG   [ ]   [ ]

   c. MAYBE   [ ]   [ ]   [ ]

(H) Phàasàa and Pháasǎa

1. a. [| | | |]   b. [| | | |]

   c. [| | | |]   d. [| | | |]

   e. [| | | |]   f. [| | | |]

2. Consonants [ ]   [ ]   Vowels [ ]   [ ]

   Tones [ ]   [ ]